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What if the Russians don't ratify?

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Abstract

Russian ratification of the Kyoto Protocol (KP), vital for the KP to enter into force, is still uncertain. This report evaluates a number of options to save the KP in case no Russian ratification takes place in the foreseeable future. It shows that some of these alternatives may be environmentally more effective than in the case of the present KP, due to the amount of surplus emissions (hot air) avoided when Russia does not participate. They could also result in more Clean Development Mechanisms (CDM) revenues for developing countries, without leading to higher costs for the participating industrial countries. However, both setting up an alternative framework outside the KP and amending the KP raise legal and practical problems that pose serious obstacles for preserving the KP without Russian participation. The best way to stimulate Russian ratification seems highlighting the economic and political gains of ratification, and – if needed – linking the issue of ratification to other issues, such as Russian membership of the World Trade Organisation. By involving policy makers at the highest level (i.e. heads of state) a political deal might thus be reached.

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Samenvatting

Ratificatie van het Kyoto Protocol (KP) door Rusland, noodzakelijk voor de inwerkingtreding van het Kyoto Protocol, is nog steeds onzeker. Dit rapport evalueert een aantal opties voor behoud van het KP in het geval Rusland niet (op afzienbare termijn) ratificeert. Het rapport laat zien dat de milieu-effectiviteit van sommige alternatieven beter is dan het huidige KP door de hoeveelheid surplus emissieruimte (hot air) die wordt vermeden als Rusland niet ratificeert. Tegelijkertijd leiden sommige alternatieven tot meer inkomsten uit CDM (Clean Development Mechanisms) voor ontwikkelingslanden, zonder dat dit resulteert in veel hogere kosten voor de (deelnemende) industrielanden. Echter, in alle gevallen vormen de juridische en praktische problemen die samen hangen met het opzetten van een alternatief juridische raamwerk of amendering van het KP, een groot obstakel voor het behouden van het KP zonder Rusland. De beste manier om Russische ratificatie te bewerkstelligen lijkt het benadrukken van de politieke en economische voordelen van ratificatie en - zo nodig – ratificatie te koppelen aan andere vraagstukken zoals toetreding van Rusland tot de wereldhandelsorganisatie. Middels de betrokkenheid van beleidsmakers op het hoogste niveau (staatshoofden) kan dan wellicht tot een politieke deal worden gekomen.

1 Introduction

Since its adoption in 1997, various developments in international climate policy have cast serious doubt about the future of the Kyoto Protocol (KP), the first international agreement containing binding emission targets for greenhouse gas emissions. These targets should result in an overall reduction in the greenhouse gas (GHG) emissions of the Annex I (industrialised) countries of about 5.2% compared to base-year 1990 levels (UNFCCC, 1998). The first blow came in December 2000 at COP-6 in The Hague, when no agreement on rules for the implementation of the KP could be reached. The second blow to the agreement came in March 2001, when the incumbent Bush Administration announced that it would not ratify the KP because it considered the Protocol too costly for the United States while wrongly excluding major developing countries (Brewer, 2003). This decision raised fears that other countries, like Canada, Japan and Russia, might also withhold their ratification. However, the survival of the KP seemed to be guaranteed when agreement was reached after further negotiations in Bonn and Marrakech, resulting in some relaxation of the commitments, in particular for Japan, Russia and Canada¹ (UNFCCC, 2001). Only Australia followed the decision of the US not to ratify the KP.

Many hoped that the Marrakech Accords opened the way for a quick entering into force of the Kyoto Protocol. For this to happen it is necessary that 55 Parties to the Convention ratify (or approve, accept, or accede to) the Protocol, including Annex I Parties accounting for 55% of that group's carbon dioxide (CO₂) emissions in 1990 (Article 25.1 KP). After the withdrawal of the US (with a share of 36.1%), these terms have put the fate of the KP in the hands of Russia as this country – with its share of 17.4% of the 1990 emissions – is crucial to reach the 55% requirement. Although the Ukraine has recently (12 April 2004) ratified the KP (see www.unfccc.int), this has not changed the need for Russian ratification.²

Not only has Russia up to now not ratified the KP, it has not even started its ratification process. This has put the EU and other countries that have ratified the KP in an awkward situation. Even in the most optimistic case, that is if the Russian government completes its evaluation of the KP and decides to send it for ratification to the Duma before the middle of 2004, the KP will probably only enter into force in the course of 2005 (Kokorin, 2003), with a first COP/MOP late 2005. If the Russian ratification were to be further delayed, the fate of the KP would be come very uncertain, as other countries may defer from it as well. This raises the question what the policy options for the European Union and other countries would be if Russia decided not to ratify or continued to delay its decision to do so.

In this report, we will evaluate a number of possible options if Russia did not ratify the Kyoto Protocol. We will start with a closer look at the background of the Russian reluctance to ratify (Chapter 2). Next, we will discuss the implications of Russian policy and possible policy responses, and conditions under which these would be legally and politically viable (Chapter 3). In Chapter 4 we will start our quantitative assessment of the environmental and economic implications of various policy options with an evaluation of the Marrakech Accords, followed by an evaluation of a number of alternative options in

¹ The Marrakech Accords settled a number of issues affecting the costs of implementation of the KP targets, including the incorporation of sinks (including sinks from forest management), no limitations on emissions trading and de facto full convertibility of the various emissions certificates from Joint Implementation (JI) (ERU), and Clean Development Mechanism (CDM) (CERs) and International Emissions Trading (IET) (Assigned amount units, or AAUs) (UNFCCC, 2001), as being analysed in literature (e.g., den Elzen and de Moor (2002a) and Grubb et al. (2003)).

² Five countries that have not ratified the KP at the time of writing (November 2003) are Liechtenstein (0.0% of 1990 emissions), Monaco (0.0%), Australia (2.1%), Russian Federation (17.4) and US (36.1%).

Chapter 5. In Chapter 6 we will look specifically at the legal and institutional aspects of the various policy options. Finally, in Chapter 7 we will derive a number of conclusions from our evaluation and suggestions for policy making.

2 The case of Russian ratification

From the beginning, it was clear that Russian ratification of the KP would not be straightforward. The withdrawal of the US from the KP significantly changed the economic prospects for Russia. Due to its economic crisis Russian emissions fell dramatically during the 1990s, and are generally expected not to reach 1990 levels during the KP first commitment Period (2008-2012). With its KP target to stabilise GHG emission at 1990 levels, Russia would be able to sell large amounts of surplus emissions ('hot air'), particularly to the US. With the US withdrawal from the KP, Russia lost its largest potential buyer of its surplus emission permits. Observers familiar with domestic Russian policy making also pointed out that the country's complex internal procedures and issues of competence and interests could also make the Russian ratification a lengthy process and that there was also internal opposition to be expected (e.g. Korppoo (2002)).

Nevertheless, in June 2002 at the World Summit on Sustainable Development in Johannesburg, the Russian prime minister Kasyanov ensured the world that Russia would ratify "in the very near future" (AP, 2002). Many hoped that Russia would announce that it would soon ratify the KP at the World Climate Change Conference (WCCC) 2003, 29 September – 3 October in Moscow. Instead, in his speech President Putin made it clear that Russia needed even more time to study the economic implications of the Protocol, and left it open as to when the KP would be sent to the Duma (the Russian parliament) for approval for its ratification. These developments have led to speculations on the reasons behind this Russian behaviour and the prospects for the KP. While there are various analyses of the problems related to the ratification process in Russia (Korppoo, 2002; Kotov, 2002; Müller, 2003; Sabonis-Helf, 2003), the exact reasons for the present position of the Russian government are not easily to establish. We can only think of two plausible hypotheses.

The first and most likely hypothesis is that of Russian brinkmanship. It assumes that the Russian government still intends to ratify, but wants to postpone the process in order to use its bargaining power to get more concessions (Baker & MacKenzie, 2003; Buchner et al., 2003). This would explain why the government keeps sending contradictory signals on its position on the KP. The concessions it aims for may relate to securing European (JI) investments in Russia after the withdrawal of the US, and to concessions in other policy areas, like the membership of the World Trade Organisation (WTO) (Bloomberg, 2003; ICTSD Bridges Weekly, 2003; Kyodo news, 2003).³ This strategy has worked before during the Marrakech negotiations where it resulted in generous quota for forest management sinks and may work again. While it seems unlikely that the European Union (EU) would give Russia any formal guarantees on the sale of emission permits, it has already made efforts to enhance European investments in the energy sector and JI projects⁴ and other concessions may follow. Recent developments also indicate a more flexible EU position on the Russian WTO membership.⁵ Such concessions may help the Russian

³ On both issues the EU and Russia have different views. The EU has demanded an adjustment of domestic energy prices before Russia would be allowed to become a WTO member and rejected Russian demands for lifting visa requirement for Russians who want to travel to the (new) EU member states.

⁴ With the introduction of the EU Emission Trading Scheme (ETS) and the enlargement of the EU, Russia fears energy investments will predominantly go to the new eastern member states. The EU commission has proposed a directive enabling linking JI en CDM projects to the EU ETS. This should prevent discrimination against investments in Russia. The EU has offered 2 million euro (??) to prepare for JI investments in Russia. In addition, in support of the ETS the European Investment Bank (EIB) will set up a Dedicated Financing Facility (DFF) of 500 million euro (?) for three years for project investments in GHG mitigation measures both inside (2/3) and outside the EU 25 (1/3) (see EIB web site: www.eib.org).

⁵ During an EU-Russian meeting early November 2003 the EU did not yet give up its demands for higher energy prices, but in a common statement it was concluded that Russian WTO membership could be due by

government to overcome internal political opposition, although this does not seem necessary to get Duma approval for ratification as Putin's party has a majority in parliament (Kokorin, 2003).

An alternative hypothesis would be that there is serious opposition against the KP in Russia based on the strong views that ratification is contrary to its national interests. This position may be related to the perceived implications of climate change for Russia, the economic benefits of the KP and Russia's long-term interests as one of the world's major energy exporters.⁶ While several studies have pointed out the negative impacts of climate change for Russia – such as the impacts of melting permafrost on infrastructures and pipelines and water problems in main agriculture production regions (Alcamo et al., 2003) - others indicate benefits related to improved navigation in the Arctic sea and northern rivers and improved conditions for agriculture, tourism, and mining in northern regions (IPCC, 1998). At the same time, the economic gains from the KP forecasted in many western economic studies (e.g., den Elzen and de Moor (2001; 2002), Buchner et al. (2002)) are downplayed. Due to the withdrawal of the US the revenues from IET and JI will be much lower than initially expected.⁷ In addition, it is feared that the enlargement of the EU and inclusion of the new member states in the internal European Emission Trading System will make it easier for the eastern European countries to supply emission reductions to Western Europe than Russia and the Ukraine. It is even claimed that given the high levels of economic growth over the last few years (on average 6.4 percent for 1999–2002) (World Bank, 2003) and the policy plan to double GDP levels over the next 10 years (2002–2012), Russian GHG emissions may again reach their 1990 levels before 2012. Ratification of the KP may then hinder attaining economic objectives. This view has in particular been expressed by Putin's advisor Andrei Illarionov, both during the WCCC (RussiaJournal, 2003), as well as in more recent statements (The Moscow Times, 2003a; The Moscow Times, 2003b).

However, fears that Russian emissions would again reach 1990 levels by 2010 do not seem to be well founded. This can be illustrated by a simple calculation. A doubling of Russia's GDP between 2002 and 2012 would require an average of 6% economic growth per year. For Russia's emissions to overshoot their Kyoto target, they would have to grow on average by more than 4% per year in the same period (see also Text box 1). This would imply an improvement in the emission intensity of the Russian economy of less than 2% per year, which is about the rate in the 1996–1999 period when the Russian economy was still stagnating (-1.9%) (World Bank, 2003; NCR, 2003). It is questionable if Russia will be able to sustain the high rates of economic growth in the 1999–2002 period, as these were largely affected by high oil prices and the 4–5% in 2001–2003 already showed a slow down in economic growth. For 2004–2005 the World Bank also projects growth rates of 4.5% per year (World Bank, 2003). But even if this were the case, it seems implausible that the rate of emission growth would keep up with economic growth to that extent as pointed out by Grubb (2004) referring to the experience in the other Eastern European Economies in Transition. The high emission intensity of the Russian economy compared to other industrialised countries indicates that the potential for reducing the emission intensity of the Russian economy is very large (Figure 1).

2005. More recent signals from the EU commission seem to confirm a willingness on the EU side to make a deal on Russian WTO membership and ratification of the KP (Reuters, 2004).

⁶ In 2003, Russia started challenging Saudi-Arabia as the world's largest energy exporter (Cox, 2003).

⁷ Some studies highlight feedback effects that can mitigate the fall in the permit price. Strategic market behaviour can indeed modify the size of the expected changes in prices and abatement costs, but these changes are much smaller than initially suggested. For example, banking and monopolistic behaviour in the permit market (Böhringer and Löschel, 2001; den Elzen and de Moor, 2001; Manne and Richels, 2001) or strategic R&D behaviour (Buchner et al., 2001) can offset the demand shift and reduce the decline of the permit price consequent to the US withdrawal from the KP.

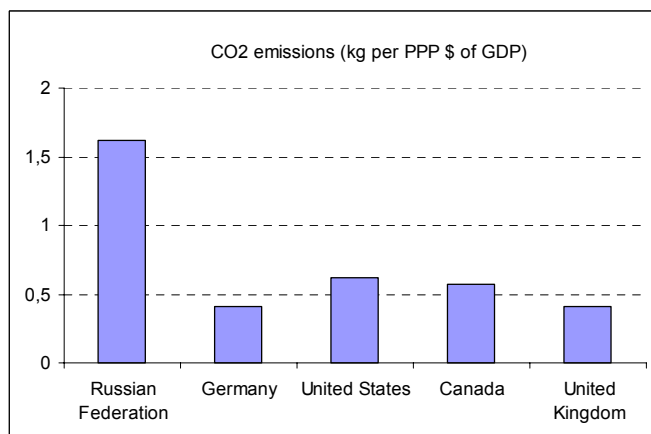


Figure 1: Emission intensity of Russian Federation versus selected other countries. CO₂ emissions relate to energy use only. (Source: World Bank World Development Indicators 2003)

If emission levels are projected to reach 1990 values again before 2012, this points at a very large unused potential for cost-effective emission reductions that via JI projects. Thus, if Russia were not able to gain from selling surplus emissions, which seems very unlikely, the KP would be very profitable to Russia because of the revenues from the large potential for emission reductions under JI projects. In fact, JI projects are probably more important for Russia than emission trading because they will result in earlier foreign investments, that will help modernise the Russian economy and increase its resource efficiency.

Russia's reluctance to ratify the KP could also be based on concerns about the economic impacts of climate policies on the longer term – beyond 2012 (de Klerk, 2003). With continued economic growth emissions may eventually again reach 1990 levels and require real emission reduction efforts (see Russia's Third National Communication (NCR, 2003)). At the same time, continued climate policies will increasingly affect the interests of Russia as a major energy producer.⁸ Whether such considerations really play a role is hard to say. In any case, ratification of the KP will not affect Russia's position regarding any future commitments, as these will again require its consent to be binding. Thus, Russia might as well ratify even if it has doubts on its long-term benefits.

⁸ The impacts from foregone energy exports revenues could become substantial, in particular under stringent future climate policies (see e.g. Criqui et al. (2003)).

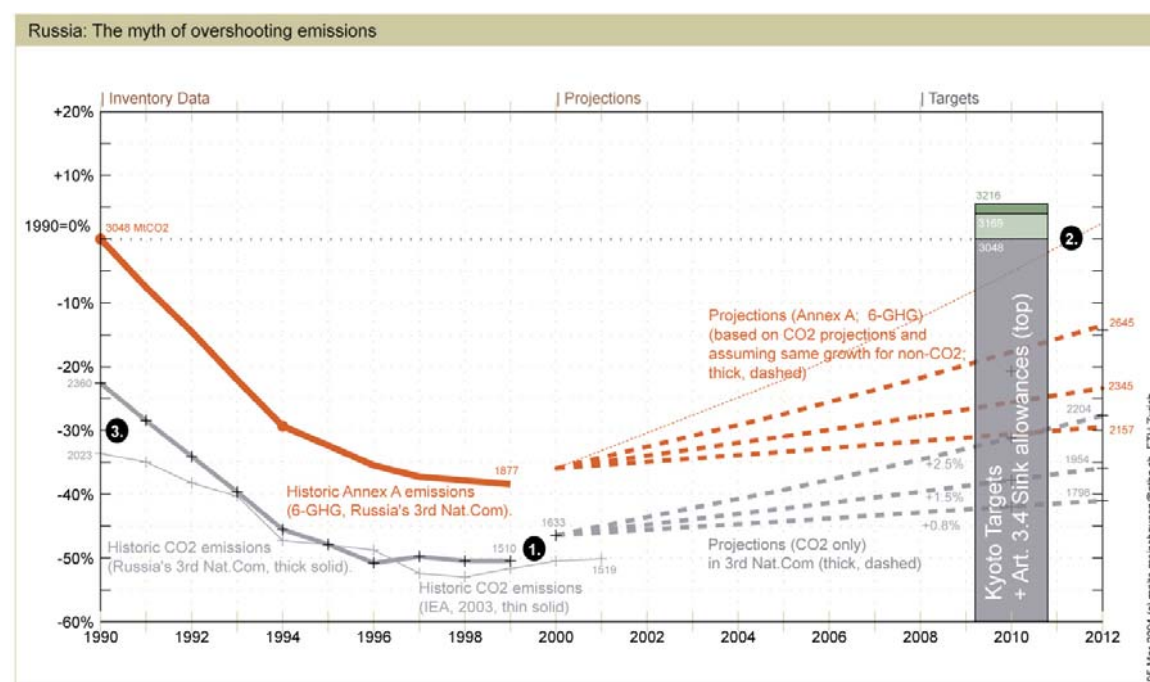
Box 1: Are Russia's emissions going to overshoot its Kyoto targets?

Figure 2: Emissions, projections and targets for Russia. See text. (Source: Meinshausen (2004))

The historic greenhouse gas emissions (CO₂, CH₄, N₂O, and fluorinated gases, red solid line) decreased sharply from 3048 to 1877 Mt CO₂eq/yr between 1990 and 1999, according to Russia's Third National Communication. Russia gave projections for CO₂ only. A low, medium and high growth scenario lead to CO₂ emissions at the end of the first commitment period (2012) of 1798, 1954 and 2204 MtCO₂/yr, respectively. Assuming the same growth for the non-CO₂ GHGs, Russia's emissions would increase up to 2012 to 2157, 2345 and 2645 MtCO₂eq/yr, for the low, medium and high growth case respectively (red thick dashed lines). Thus, even the high growth scenario will stay 300 to 450 MtCO₂eq/yr below the Kyoto targets in 2012. The Kyoto targets (bar on right) consists of the Assigned Amount Units equal to 1990 emissions (dark blue), and additional generous sink allowances for forest management (bright green bar section) and agricultural management activities (dark green bar section), respectively. Only an unrealistic annual emission growth of more than 4% per year would hit the 1990 emission line within the first commitment period (see thin dotted line and point 2). For a more extensive discussion of various projections of Russia's GHG emissions see Chapter 5.

3 Where do we go from here?

Recent developments have put the EU and other members of the present (2003) KP coalition (the Annex I Parties that have ratified the KP) in an awkward situation. In the present situation, the most pessimistic scenarios about the moment of Russian ratification of the KP envisaged before the World Climate Change Conference (WCCC) in Moscow (September, 2003) have become the most likely ones (see e.g. de Klerk (2003)). Even in the rather optimistic case, where the period for further evaluation of the KP by the new Russian government is kept short and it eventually decides to send it for ratification to the Duma in the middle of 2004, the KP probably will only enter into force in the course of 2005 (Kokorin, 2003), with a first COP/MOP late 2005. If the Russian government waited with the ratification process until after the presidential elections in the US in November 2004, the future of the KP could seriously be at stake. With no clear prospect for the KP to enter into force within a foreseeable future, the political support for going ahead with the KP commitments may seriously erode, even within the EU.⁹

But there are a number of other problems posed by a late ratification of Russia. First, it will result in a critical delay of the internal preparations for the implementation of the KP for both governments and businesses, increasing the costs of implementation and risk of non-compliance.

Secondly, the cost-effective potential for JI and CDM projects is reduced due to the shortening of accounting periods. The attractiveness of JI and CDM projects is dependent on the length of the period they can produce emission credits. In the case of CDM projects this period can start already before the first commitment period (2008-2012). Uncertainty about whether the KP will enter into force is likely to result in a delay of such investments. This will reduce the revenues from such mechanisms for developing countries and Economies in Transition.

Third, without the KP having entered into force, any (formal) discussions on post-Kyoto commitment may remain blocked as the EU already painfully experienced during COP-8. Without Russian ratification it seems unlikely that developing countries will be prepared to participate in any such formal discussions. Without the KP enforced, there is also no legal obligation to start negotiations on post 2012 commitments by 2005. Given the complexity of the issue, this means it will become nearly impossible to reach any deal before the first commitment period has started, should the KP enter into force. Finally, if the second hypothesis were to be correct all further efforts to make the Russian ratify the KP would eventually turn out to be in vain.

For these reasons, the EU and the other members of the KP coalition need to start with some contingency planning. There should be a plan B in case Russia does not ratify the present KP. What would be the options? In response to the withdrawal of the US from the KP there have been some proposals for making a new start (e.g. Müller et al. (2001), Aldy et al. (2003)¹⁰, Babiker and Eckhaus (2002)). Many of these assume the KP to be dead or relate to the post-Kyoto period (beyond 2012). However, while starting new poses the best

⁹ Within the EU concerns about the impacts of implementing the KP on industrial competitiveness are already gaining political ground, with doubts being raised on the side of Member States, EU Commissioners and the industry (Environment Daily, 2003).

¹⁰ There are also some studies suggesting the involvement of major developing countries (in particular China) in the KP, possible on the basis of a conditional binding commitment (Buchner et al., 2003; Philibert, 2000). However, the response to the proposal of Argentina (1998) has made clear that there is major opposition amongst the G77 group against some developing countries breaking ranks.

opportunities for redesigning international climate policies, it is also likely to result in a substantial delay of one or more decades in implementing climate policies. After more than a decade of negotiations, the event of the KP becoming a dead letter is likely to result in a general loss of faith in international environmental policy making (Grubb et al., 2003).

Box 2: Ukraine's GHG emissions projections in the Nation Strategy Study (Worldbank, 2003)

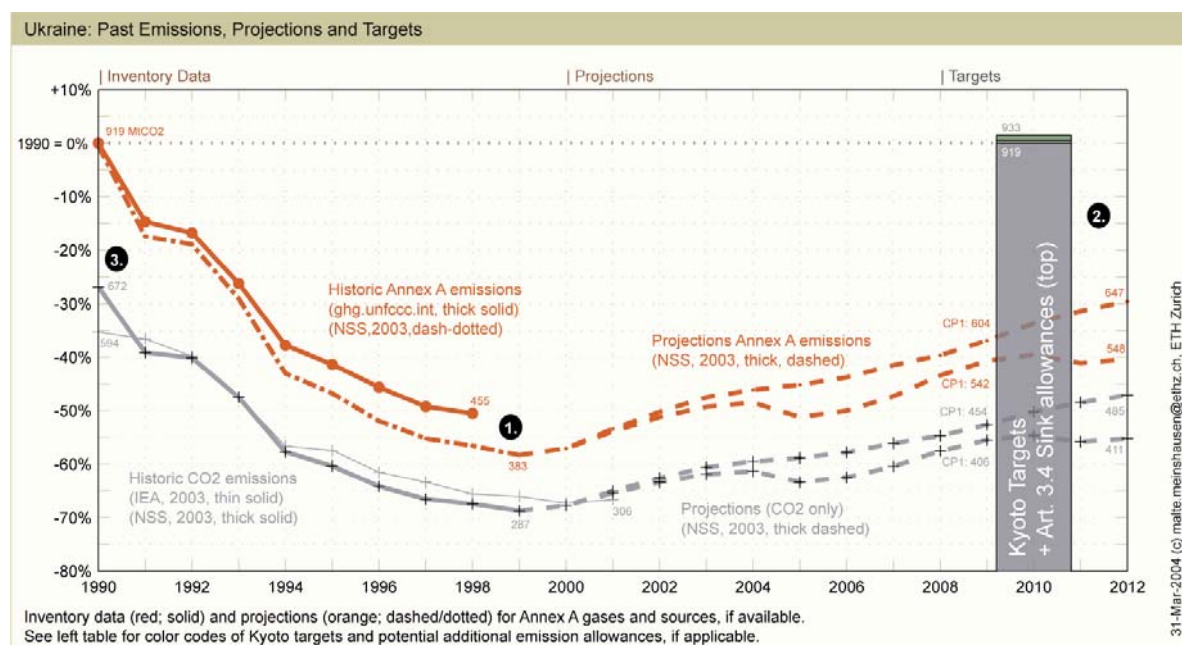


Figure 3: Emissions, projections and targets for Ukraine. See text. (Source: Meinshausen (2004)).

The historic greenhouse gas emissions (CO₂, CH₄, N₂O, and fluorinated gases, red solid line) decreased sharply from 919 to 383 MtCO₂eq/yr between 1990 and 1999 (see Figure 3). In the National Strategy Study (NSS) for the Ukraine (NSS, 2003), the Ukraine Ministry of Environment and Natural Resources presents two different scenarios for economic growth: a high economic growth scenario and a low economic-growth scenario. The first scenario predicts that 1990 levels of GDP will be reached again in the year 2009, while the second and less optimistic scenario sees GDP still at about 60% of 1990 levels during the first commitment period of the Kyoto Protocol (2008-2012). With respect to expected GHG emissions, the two scenarios do not differ significantly. While in the high economic growth scenario GHG emissions are predicted to reach about 68% of the 1990 level by 2010, the low economic growth scenario shows GHG emissions at 62% of the 1990 level in the year 2010. The reason for the small difference in terms of GHG estimates is that the pessimistic scenario is associated with low energy efficiency and high GHG intensity, while with fast economic growth, energy efficiency is improved significantly.

The NSS shows that the Ukraine will have surplus GHG permits under any plausible scenario at least until 2020. In the fast economic growth scenario, total CO₂ emissions in 2010 will reach 68.2% of the 1990 level and Ukraine will have a surplus of AAUs, which amounts to about 32% of the 1990 level (e.g., 215.1 Mt of CO₂ in 2010 or 1,075 Mt of CO₂ during the period 2008-2012). In the low-economic-growth scenario Ukraine will have a surplus of the AAUs which amount to about 38% of the 1990 level (e.g. 255.4 Mt of CO₂ in 2010 or 1,277 Mt of CO₂ during the period 2008-2012)). In this scenario energy and emission intensity of GDP will not change.

Similar to Figure 2, the Kyoto targets (bar on right) consist of the Assigned Amount Units equal to 1990 emissions (dark blue), and additional generous sink allowances for forest management (bright green bar section) and agricultural management activities (dark green bar section), respectively.

The recent ratification of the KP by the Ukraine has in principle substantially improved the conditions of going ahead with the KP without Russia. Ukraine is one of the countries which has to gain most from the Kyoto Protocol, and even more so if Russia does not ratify. Like Russia, the Ukraine is likely to have substantial amounts of surplus emissions (see Text box 2) and can thus generate significant revenues by selling emission credits. Furthermore, by implementing Joint Implementation projects, Ukraine could attract foreign investment into various economic sectors of the country. At the same time, this would allow other countries that have ratified the KP to meet their KP targets at lower costs.

However, the amount and price of emission credits from the Ukraine is uncertain due to potential problems related to meeting eligibility requirements for emission trading and strategic (monopolistic) market behaviour. So far the country has not set up the institutional infrastructure necessary to either sell emission credits via the international emissions trading framework or attract Joint Implementation investment – not to mention the capacity necessary to maximise Ukraine's benefits from the KP (World Bank, 2003). The Ukraine still needs to put into place the institutional structure necessary for Joint Implementation projects and for participating in international emissions trading. Apart from eligibility problems, the supply of emission credits could also be limited by strategic behaviour. This problem in fact will become more prominent without competing supply of surplus emission credits from Russia, giving the Ukraine a monopolistic market position.

In any case, the prospects for Ukraine ratification make it even more interesting to see if it is possible to save the KP, and postpone large regime revisions to the negotiations on a post-Kyoto regime. This would thus imply an adjustment of the KP. What conditions should such adjustments meet in order to stand any chance of being acceptable and making sense from the outset? We think the following criteria should be met:

- the new regime should make sense from an environmental perspective, that is, its environmental effectiveness should be comparable to or even better than the KP in the present situation (thus without US and Australian ratification). If this is not the case, there might be strong arguments for starting all over again.
- the costs of going ahead with the KP without Russia should remain acceptable for Annex I Parties that have ratified the Kyoto Protocol. This seems particularly critical in the case of Japan and Canada, where there is substantial opposition to the KP, and less so for the (enlarged) EU due to accession of the Eastern European countries. As indicated ratification of the Ukraine will make it easier to fulfil this criterion.
- the new arrangement should be acceptable to the non-Annex I countries as well. With both main polluters out (US and Russia) this may be politically difficult. But with the prospects that negotiations on an alternative approach to the KP will tend to focus more directly again on non-Annex I country participation, eliminate CDM investments and postpone support for climate adaptation, developing countries may be willing to go along with an adjusted KP if it does not make them worse off. In this respect, the expected revenues from CDM projects will be a particularly important criterion, as these have fallen down after the withdrawal of the US.
- the options should be politically acceptable to the Parties involved. This goes beyond the simple economic outcomes to be expected.
- the options should be practically and legally feasible to be implemented. This criterion concerns issues such as legal and institutional requirements for making the various policy adjustments and the time and policy efforts involved.

In the remainder of the report we will explore if there are any options that would meet all these criteria. The environmental and economic criteria will be quantitatively assessed in the next two chapters (Chapter 4 and 5); the legal and institutional feasibility of the options will be dealt with separately (Chapter 6).

4 What will be the costs and environmental effectiveness of the Marrakech Accords?

Before we analyse alternatives to the KP, we will first review the implications of the KP after the Bonn Agreement and Marrakech Accords, in case Russia – like Ukraine – did ratify. This case will be used as reference case for comparing the alternatives. The evaluation focuses on the environmental effectiveness and economic efficiency of the KP in the first commitment period, i.e. 2008-2012. The environmental effectiveness is represented by the emissions of six key GHGs¹¹, expressed in CO₂-equivalent emissions relative to their base-year emissions for the Annex I Parties excluding the US and Australia. This is calculated using the UNFCCC base-year emissions and the quantified emission limitation or reduction commitment (QELROs) of the KP¹² (UNFCCC, 2003), taking into account the decision on sinks in Bonn and Marrakech (for more details, see den Elzen and de Moor (2001; 2002a; 2002b)). For the sinks, using FAO data to quantify Article 3.3 activities and agricultural management and applying the country specific caps on forest management and the cap of 1% of base-year emissions for CDM-sinks, we calculate the sinks credits at 120 MtC maximum (den Elzen and de Moor, 2002a) (see Appendix A).¹³ Economic efficiency is represented by total abatement costs (in 1995US\$) for Annex I countries to comply with their Kyoto commitments, and the expected average clearing price in the international permit market over the commitment period, as calculated using the abatement costs model of FAIR 2.0 (Framework to Assess International Regimes for differentiation of future commitments) model (den Elzen and Lucas, 2003) (Appendix B).

The present multi-gas analysis of the KP is an update of our previous analysis, which was based on CO₂ emissions only (see den Elzen and de Moor (2002a; 2002b)). Here, we use Marginal Abatement Costs (MAC) curves for fossil CO₂ curves derived from a (physical) energy model, instead of those derived from an economic general equilibrium model. These are more compatible with the non-CO₂ MAC curves used derived from bottom-up technology studies. Generally, these type of MACs give somewhat higher cost estimates, in particular on the short-term, because they reflect inertia in the energy system better and do not account for structural change induced by carbon taxes. Like in den Elzen and de Moor our scenario is the IMAGE 2.2 implementation of the IPCC SRES A1B scenario (IMAGE-team, 2001). This baseline scenario can be characterised as a scenario showing increasing globalisation and a rapid introduction of new and more efficient technologies and high economic growth. For the reference case we assume an optimal level of banking of excess emission allowances¹⁴ by Russia and Ukraine and implementation of the proposed GHG intensity target by the US (-18% between 2002-2012) (White-House, 2002).

¹¹ The GHGs involved include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

¹² Article 3.5 of the KP allows Bulgaria, Hungary, Poland and Romania to use base-years other than 1990. According to Article 3.7, Australia in particular is allowed to add its 1990 emissions from deforestation to their base-year emissions. Article 3.8 grants particularly Japan to use 1995 as the base-year for some non-CO₂ gases. These provisions result in 2010 emissions different relative to base-year levels than when compared to the 1990 levels (see den Elzen and de Moor (2002a)). We calculate Annex I emissions without the US and Australia at about 0.66% above 1990-levels instead of -1.1% below base-year levels.

¹³ Note that our methodology does *not* include sinks as abatement efforts. However, they do *remove* CO₂ and hence decrease the atmospheric CO₂ built-up. Therefore, we present Annex I efforts both excluding and including removals through sinks, assuming zero-cost sinks options (Appendix A).

¹⁴ A policy of optimal banking would, ideally, also consider permit prices in future commitments periods to be inter-temporally optimal. As targets for the second commitment period and beyond are yet unknown and uncertain, optimal banking is here interpreted as maximising revenues in the first commitment period.

Table 1 presents the results for this case. Our analysis shows that the financial revenues of Russia and the Ukraine are maximised by banking 55% of their surplus emissions, as illustrated in Figure 4. The permit price will increase from US\$13/tC to US\$28/tC. Due to banking, fewer surplus emissions are supplied on the market, which raises the environmental effectiveness. More specifically, the Annex I (excluding Australia and US) emissions are now 5.4% below base-year levels, instead of only 1.1% without banking (and 9% with 100% banking) (see Figure 3b). However, the banked surplus emissions will be released at a later stage, when Russia and the Ukraine use them to meet their post-Kyoto targets. The total GHG emissions of all Annex I countries (including Australia and US) in the 1990-2010 period increase to 8.3% above base-year levels, with an increase of about 33% for the US.

The mitigation costs for the Annex I countries (excluding Russia; including the Ukraine) are in the order of 10 billion US\$ per year, or less than 0.05% of projected GDP in 2010. Both Russia and the Ukraine profit from the KP with gains of about bUS\$4 and bUS\$1 per year, respectively. Under optimal banking, the gains for the non-Annex I Parties are in the order of bUS\$2 per year (see also Figure 3b). Given the large differences in income between the regions, we also compare the mitigation costs (or gains) to the regional GDP levels (the ratio is further referred to as 'effort rate'). This gives an indication of the relative weight of the mitigation costs (or gains) in comparison with to the size of the economy.

Table 1. Environmental effectiveness and costs of the Marrakech Accord: KP with optimal banking by Russia and Ukraine and without US and Australia

Case 0 Marrakech Accord	Environmental effectiveness		Economic efficiency		
	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
Annex I ratified KP	2266	-4.1	28	10.20 ^V	0.05 ^V
EU enlarged	1484	-5.9	28	6.6	0.05
Japan	331	-1.1	28	2.0	0.03
Canada	175	5.2	28	1.5	0.18
Ukraine	234	-6.8	--	--	--
Russia	694	-16.3	28	-4.7**	-0.59**
Annex I (excl. US+Aus.)	3019	-5.4	28	5.4	0.03
non-Annex I			28	-1.9	0.01

--: Not available; ** Ukraine and Russia together; ^V Excluding gains Ukraine and Russia

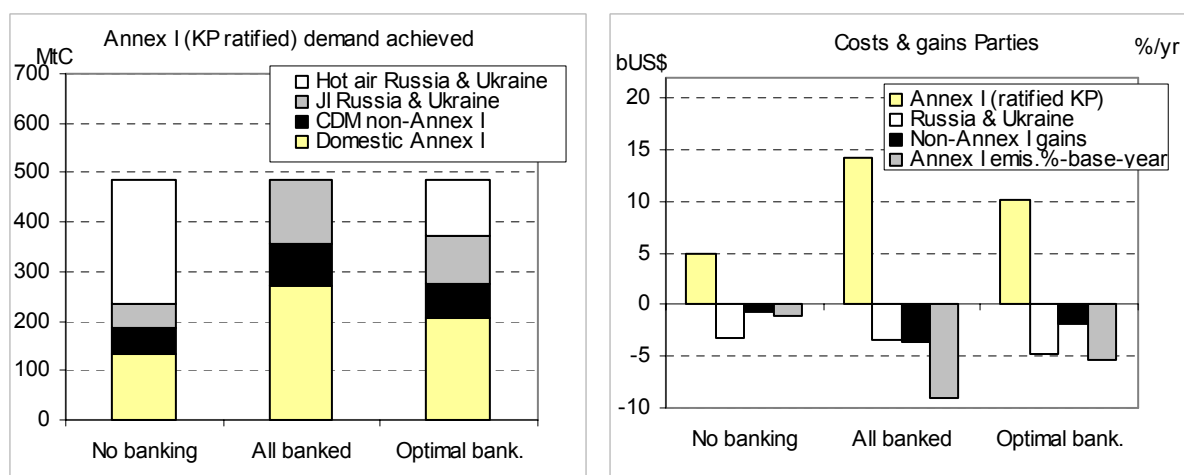


Figure 4: The components of the total Annex I (KP ratified) emission reductions (domestic, hot air (surplus emissions), JI and CDM) (a:left) and the annual costs and gains of the different Parties and environmental effectiveness (b: right) under no banking, all banked and optimal banking.

5 Alternatives to the present Kyoto Protocol

We now consider three options to save as much of the KP as possible if Russia was unwilling to ratify, that may also meet the requirements set out in the previous section. Table 2 presents an overview of the environmental effectiveness and costs of all cases compared, i.e.:

- case 0: Marrakech Accord: KP with optimal banking by Russia and the Ukraine but without US and Australia
- case 1: Restoration of the KP: getting the US back
- case 2: Meeting KP targets without KP entering into force
 - case 2a: without use of KMs
 - case 2b: only IET/JI among KP regions
 - case 2c: enhanced CDM
- case 3: Amending the KP
 - case 3a: amended 55% requirement
 - case 3b: amended 55% requirement + enhanced CDM
- case 4: KP without Russia with adjusted targets

These various cases (options) will be described and discussed below.

Table 2. Environmental effectiveness and costs of all cases

		Case 0	Case 1	Case 2a	Case 2b	Case 2c/3b	Case 3a	Case 4
Environmental effectiveness								
Annex I ratified KP	Demand (MtC/yr)	486	834	486	486	486	486	395
Russia & Ukraine	Surplus emissions (MtC/yr)	-113	-201	0	-70*	-70*	-70*	-70*
	JI (MtC/yr)	-99	-103	0	-62*	-33*	-52*	-41*
non-Annex I	CDM (MtC/yr)	-70	-84	0	0	-207	-79	-62
Annex I	Domestic (MtC/yr)	-190	-425	-429	-316	-166	-257	-187
	IET/JI (MtC/yr)	-15	-23	-57	-38	-10	-29	-35
Netto		0	0	0	0	0	0	0
%change base-year		-5.4	-2.7	-9.0	-6.8	-6.8	-6.8	-5.7
Economic efficiency								
Permit price	US\$/tC	28	25		68	22	48	37
Annex I (ratified KP) ^v	Costs/yr (bUS\$)	10.2	13.2	21.6	18.3	6.2	15.0	10.2
Ukraine		--	--	0.0	-8.6	-2.2	-5.6	-4.1
Russia	Costs/yr (bUS\$)	-4.8**	-6.2**	0.0	0.0	0.0	0.0	0.0
Non-Annex I	Gains/yr (bUS\$)	1.9	2.1	0.0	0.0	3.5	3.7	2.4

--: Not available; * Only for Ukraine; ** Ukraine and Russia together; ^v Excluding gains of Ukraine and Russia; ^{vv} Including costs for US and Australia

Methodological note: the singling out of the Ukraine in the calculations

Compared to our previous calculations (e.g. den Elzen and the Moor, 2002), we here had to account for the Ukraine joining the group of countries ratifying the KP if Russia does not. As the Ukraine is not a separate region in our FAIR model, but part of the former Soviet Union, special assumptions and additional calculation had to be made to separate the share of the Ukraine in both emission projections and the emission credits from international emission trading in surplus emissions of the former Soviet Union. This has been done in a few steps. First, the relative drop in emission levels of Russia and the Ukraine from 1990 levels were determined. Instead of assuming an equal reduction, information from emission trends from the IEA (2003) for the Ukraine were taken. This approach results in a much

larger reduction in Ukraine emission levels by 2000 than for Russia (see text boxes 1 and 2). Next, the economic and emission growth trends in the IMAGE A1 scenario were applied to both regions. This results also into a more than proportional share of Ukraine in the 2010 surplus emissions of the former Soviet Union region. By 2010 Russia's emissions would be about 17% while Ukraine's emissions would be around 27% below their 1990 (base year) levels. For calculation of emission reduction cost, the FAIR model does not include separate MACs for Russia and Ukraine. In the cases where both Russia and Ukraine participate (the Marrakech Accord and the Restoration case with the re-entrance of the US (cases 0 and 1 in table 2), we have thus not tried to separate JI revenues for each region. However, in the cases where only the Ukraine participates the revenues from JI projects had to be estimated separately. This has been done by re-scaling the MACs for the former Soviet Union region to the Ukraine baseline, which can be considered a rough but reasonable approximation. However, given this approach the figures for the Ukraine need to be viewed with due care.

5.1 Option 1: Restoration of the KP: getting the US back

A first option would be restoration of the KP by getting the US back on board. This would have two important effects: economically it would make the KP much more attractive for Russia, while politically it would make it more difficult for Russia to deflect. A change in the US position under the Bush administration is however very unlikely. The most likely way the prospects may change is if the Democrats win the November 2004 presidential elections. However, even with a Democratic president the original US targets will have to be adjusted for the US to come back. One option would be to select the target proposed in the McCain-Lieberman proposal (US-Congress, 2003), asking for a return of US GHG emissions at 2000 levels by 2010. Between 1990 and 2000 US GHG emissions have increased by 13% (UNFCCC, 2003). The US would thus get a growth target, but this would still imply a substantial effort as US emissions are projected to grow by about 17% over the next decade (EIA, 2004). We used the FAIR 2.0 model to evaluate the environmental and economic implications of this US re-entrance case. In our calculations we assumed the former Soviet Union regions to use the option of banking AAUs to optimise their revenues in the 2008-2012 period. Detailed results are given in Table 3 and Figure 5.

Table 3. Environmental effectiveness and costs of meeting KP with US re-entrance with McCain-Lieberman target

Case 1	Environmental effectiveness		Economic efficiency		
	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
Restoration of the KP: getting the US back					
Annex I ratified KP	2287	-4.1	25	13.2 ^v	0.04
EU enlarged	1484	-5.9	25	6.0	0.05
Japan	331	-1.1	25	1.8	0.03
Canada	175	5.2	25	1.4	0.16
Ukraine	254	1.4	25	--	--
Russia	827	-0.2	25	-6.2*	-0.78*
Annex I (excl. US+Aus.)	3107	-2.7	25	3.0	0.01
non-Annex I			25	-2.1	-0.02

--: Not available; * Ukraine and Russia together; ^v Excluding gains Ukraine and Russia; including US and Australia

Re-entrance of the US (and Australia) under the McCain-Lieberman target would improve the overall environmental effectiveness of the KP as total Annex I emissions in 2010 would increase less from base-year levels: from 8.3 % with the US and Australia outside the KP to 4.7% after their re-entrance (not shown). Re-entrance of the US would also result in a substantial increase in the international demand for emission credits, and thus improve the

revenues from both emissions trading (surplus emissions), and JI and CDM projects (see Figure 4), even though the expected carbon price would be somewhat lower than under the Marrakech Accords case (with optimal banking) (Table 2). The re-entrance case would result in substantial higher revenues from emissions trading than under the Marrakech Accords case: b\$US6.2 versus b\$US 4.8 per year (Figure 5). Russia and the Ukraine would be the main beneficiaries of US re-entrance because non-Annex I countries CDM revenues would not substantially increase. The total costs of implementing KP would increase due to the re-entrance of the US and Australia, from bUS\$10.2 to bUS\$13.2 per year, but at the same time the costs for the various Parties would slightly decrease due to the lower permit price. Interestingly, the costs for the US of about 0.04% of GDP in 2010 (not shown) would be comparable to those of the EU and Japan, but less than for Canada (Table 3).

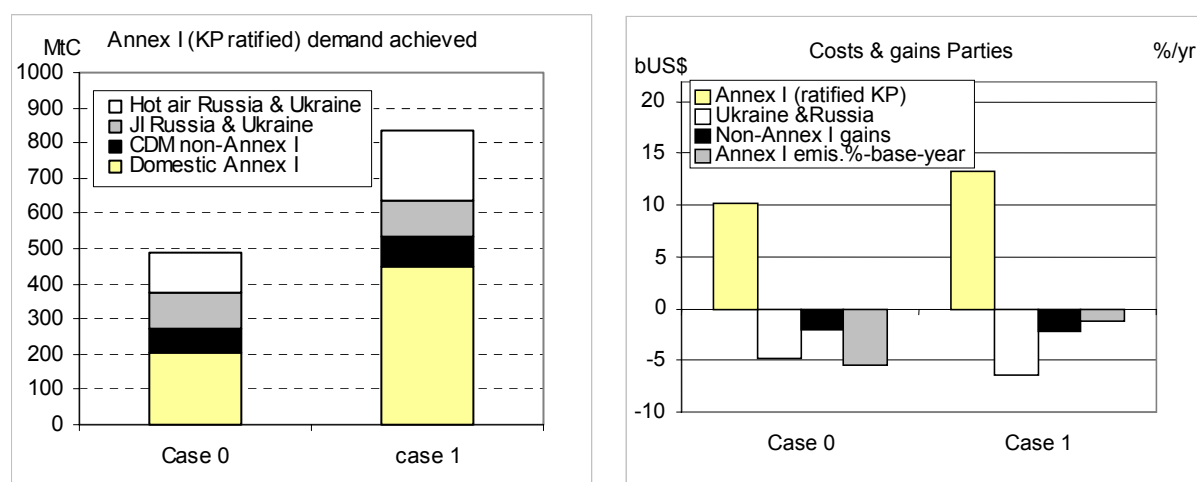


Figure 5: The components of the total Annex I (KP ratified) annual emission reductions (domestic, hot air surplus emissions), JI and CDM) (a: left) and the annual costs and gains of the different Parties and environmental effectiveness (b: right) under case 1 (compared to case 0).

While re-entrance of the US (and Australia) would thus be both environmentally and economically beneficial and result in comparable costs for the US, the EU and Japan, the political feasibility of this option is seriously questionable. First, it is uncertain whether the Democrats will win the elections. Second, even if they do it seems unlikely that they will return to the present KP even on 'US-friendlier' terms. The US resistance to the KP not only stems from the Republicans, but also finds general support among the Democrats as was illustrated by the Bird-Hagel resolution in 1997 (US Senate, 1997) and reconfirmed in the recent senate debate on the McCain-Lieberman Act (US Senate, 2003). It is possible that a Democratic Administration may be willing to re-negotiate its re-entrance to the KP.¹⁵ However, it probably would not only demand a revision of the US targets, but also new commitments for some major developing countries, like China, which would open up the KP deal altogether. This would not be acceptable for most other Parties. Thus given the expected US conditions for re-entrance to the KP, it is likely that this will eventually result in a complete re-opening of the negotiation process and abandoning of the KP. With that prospect, the KP coalition may prefer focussing the issue of US re-entrance on the post-2012 period and try to go ahead with the KP without the US.

¹⁵ For the position of John Kerry on the KP, see for example: http://www.johnkerry.com/pdf/long_enviro.pdf

5.2 Option 2: Meeting KP targets without KP entering into force

A second option is that the present KP Parties would continue to meet their targets even if the KP did not enter into force. In particular the EU has stated that it will go ahead with implementing the KP commitments irrespectively of the KP entering into force, and also adopted a directive that enables such trading in the EU from 2005 onwards.¹⁶ The Canadian minister of Environment, David Anderson, has also said that Canada would also meet its KP target if the KP does not enter into force (CTV, 2003) .

Table 4. Environmental effectiveness and costs of meeting KP targets without use of KMs

Case 2a meeting KP targets without use of KMs	Environmental effectiveness		Economic efficiency		
	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
Annex I ratified KP	2217	-6.2		21.6	0.10
EU enlarged	1484	-5.9	103	12.8	0.10
Japan	331	-1.1	114	4.3	0.07
Canada	175	5.2	168	4.4	0.52
Ukraine	184*	-26.5*	0	0.0	0.00
Russia	689*	-16.9*	0	0.0	0.00
Annex I (excl. US+Aus.)	2906	-9.0		12.8	0.06
non-Annex I				0.0	0.00

* Baseline of Russia and Ukraine

Table 4 shows that the environmental effectiveness of this option would be better than under the Marrakech case, due to the exclusion of the use of both Ukraine and Russian surplus emissions (about 250 MtC). More specifically, Annex I emissions (excluding US and Australia) would be 9% instead of 5.4% below their base-year emissions. However, this improvement comes at a price. The total costs of the KP coalition (Annex I countries excluding Russia, US and Australia) would more than double from about b\$US10 per year to almost b\$US22 (see Table 4). This would apply particularly to Canada, as the costs of meeting their relatively stringent KP targets by domestic action alone will be relatively high. While in the case of the EU and Japan, the costs double, for Canada the costs more than triple compared to the Marrakech case. This seems to indicate that meeting their KP targets without the availability of the Kyoto mechanisms would be problematic.

The economic viability of this option could be somewhat improved if the countries implementing their Kyoto targets were able to establish a system of linked emission trading schemes and project-based JI (Grubb et al., 2003) (case 2b). As this would enable the use of the surplus emissions and JI potential of the Ukraine, the implementation costs for the Kyoto countries would be reduced (see Table 5). However, we find that the costs gains are relatively small, as costs would generally still be twice as high as under the Marrakech case. It would be particularly profitable for the Ukraine, which would receive almost 9 billion US\$ per year from the sales of emission credits, mainly from surplus emissions sales (about 70 MtC equivalent). The environmental effectiveness would still be higher than under the Marrakech case, due to exclusion of the surplus emissions of Russia (-6.8% versus -5.4% for the Annex I (excluding US and Australia)).

¹⁶ The European Parliament and the Council adopted the Directive 2003/87/EC of October 13th 2003, establishing a scheme for greenhouse gas emission allowance trading within the Community. In March 2004, the EU Council reaffirmed the EU's commitment to implement its Kyoto target.

Table 5. Environmental effectiveness and costs of meeting KP targets without KMs and with only ET among KP regions

Case 2b meeting KP targets only ET among KP regions	Environmental effectiveness		Economic efficiency		
	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
Annex I ratified KP	2287	-3.3	68	18.3 ^V	0.09
EU enlarged	1484	-5.9	68	11.6	0.09
Japan	331	-1.1	68	3.7	0.06
Canada	175	5.2	68	3.0	0.35
Ukraine	254	1.4	68	-8.6	-10.2
Russia	689*	-16.9*	68	0.0	0.00
Annex I (excl. US+Aus.)	2976	-6.8	68	9.7	0.05
non-Annex I				0.0	0.00

* Baseline of Russia; ^V Excluding gains Ukraine

Apart from the relatively limited cost gains, it is questionable whether the linkage between the markets of the Kyoto countries could be established in time. Only the EU is on schedule with the implementation of an internal emission trading system. Particularly in Japan, there have been no proposals to set up an internal emission trading scheme whatsoever (Sakamoto, 2004).¹⁷ Apart from the implementation of internal emission trading systems, the development of national emission trading schemes will not automatically enable countries access to Ukraine's surplus emissions. While the EU will also adopt a so-called linking directive that allows industries participating in the EU emissions trading scheme to realise part of their emission reductions by using emission credits gained from JI projects in other Annex I countries, this linkage would not allow for trading surplus emissions. Thus, in addition to the implementation of internal emission trading systems, there would still be a need for copying the legal and institutional arrangements of the KP into a new treaty system outside the UNFCCC to enable international emissions trading and JI. This may require substantial time, as this alternative treaty system could be subject to ratification procedures in the various countries concerned.

Moreover, a major drawback of this option is that it leaves the non-Annex I countries with empty hands, both with respect to revenues from the CDM as well as the additional funding mechanism for adaptation in the Marrakech Accords. The latter problem might be (partially) "repaired" by providing more funds via alternative channels (like Official Development Assistance (ODA) and the Global Environment Fund (GEF)), but it still seems to leave the non-Annex countries worse off.

One option for overcoming the high costs for the participating Annex I countries and empty hands for the non-Annex I countries is not just to save JI and Emission trading outside the KP, but also the CDM mechanism (case 2c). This would imply also copying the legal and institutional arrangements of the present CDM into the alternative treaty system. In addition, the scale of the CDM could be enhanced by design changes that lower the implementation costs of the "new CDM mechanism". This could include particularly the following changes:

- develop sectoral next to project-based CDM (Samaniego and Figueres, 2002), and
- promote non-Annex I countries to develop their own CDM projects.

¹⁷ For this reason, Japan has expressed concerns about the proposed EU directive for linking the emission trading scheme to JI and CDM projects, because it significantly reduces the potential for Japanese JI investments in the new EU member states (Sakamoto, 2004). The future prospects for an emission trading scheme are dim, because industry (Keidanren) opposes it as it prefers regulation and agreements. For this reason it also opposes the carbon tax presently being discussed.

To explore the possible gains from a more effective CDM mechanism, we performed some sensitivity analyses with the FAIR 2.0 model by varying the assumptions about the accessibility of the CDM mitigation potential (accessibility factor) in the first commitment period (2010), from 10% to 60%. The results in Table 6 and Figure 6 show that preserving the CDM and making it more effective would considerably reduce the costs for Annex I (from b\$US 10.2 to b\$US 6.5 per year). At the same time, the revenues for the non-Annex I would be significantly higher than with Russian ratification of the KP (Marrakech case): b\$US 3.5 instead of b\$US 1.9 per year.¹⁸

Table 6: Environmental effectiveness and costs of KP without Russia, but higher CDM accessibility

Case 2c	Environmental effectiveness		Economic efficiency		
	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
KP without Russia enhance CDM					
Annex I ratified KP	2287	-3.3	22	6.2	0.03
EU enlarged	1484	-5.9	22	5.5	0.04
Japan	331	-1.1	22	1.6	0.03
Canada	175	5.2	22	1.2	0.15
Ukraine	254	1.4	22	-2.2	-0.27
Russia	689*	-16.9*	0	0.0	0.00
Annex I (excl. US+Aus.)	2976	-6.8	22	6.2	0.03
non-Annex I			22	-3.5	-0.03

* Baseline of Russia

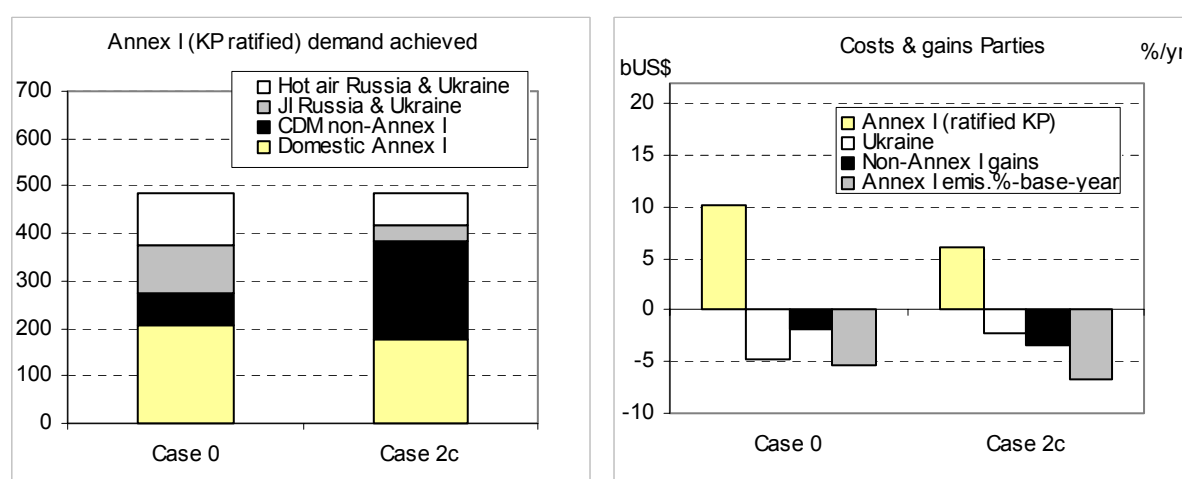


Figure 6: The components of the total Annex I (KP ratified) annual emission reductions (domestic, hot air (surplus emissions), JI and CDM) (a: left) and the annual costs and gains of the different Parties and environmental effectiveness (b: right) under case 2 (compared to case 0).

The analysis shows that the preservation and enhancement of the CDM can help reducing Annex I costs of implementing the KP targets without Russian ratification substantially, even to levels below those under the KP (Marrakech case). As to be expected, this option would also be very beneficial to non-Annex I countries.

¹⁸ It should be noted that the enhancement of the CDM effectiveness under the KP would increase the non-Annex I revenues as well.

However, setting up an alternative institutional legal structure outside the UNFCCC raises all sorts of legal and political concerns. While simply copying the present rules, structures and procedures for the Kyoto Mechanisms may be relatively simple and conceivable, re-negotiating alterations in the conditions for the Kyoto mechanisms could prove to be more complicated, particularly if all this needs to take place outside the UNFCCC system. Apart from legal and practical issues, such a development might meet political resistance due to fears of undermining the UNFCCC and the UN system. For this reason it seems more attractive to first explore other options for preserving the KP.

5.3 Option 3: An amended KP

One such an option for preserving the legal framework of the KP would be by amending it to make its entering into force no longer dependent on Russian ratification. This would require changing the 55% of 1990 CO₂ Annex I emissions requirement in the KP (Article 25.1).

However, simply changing the 55% requirement may not be sufficient (Case 3a). Table 7 shows that implementation of the KP without Russia will substantially increase the emission permit price on the international market: from \$US28 to \$US48 per ton of C, and that the total costs for those KP countries that need to buy emission credits would still be significantly higher than under the Marrakech case (b\$US15.0 instead of b\$US10.5). At the same time non-Annex I countries will gain from the absence of the Russian supply of emission permits on the market which would raise revenues from CDM to non-Annex I countries to about b\$US3.7 per year compared to about b\$US2 per year under the Marrakech Accords. Without Russia, the environmental effectiveness of the KP would also significantly increase (for the Annex I (excluding US and Australia) –7.6% instead of –5.4% compared to base year levels). So, while the environmental effectiveness would improve and non-Annex I countries would be much better off, the costs to some Annex I countries would be substantially higher than under the Marrakech Accords (reference case).

Table 7: Environmental effectiveness and costs of KP without Russia

Case 3a	Environmental effectiveness		Economic efficiency		
KP without Russia	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
Annex I ratified KP	2283	-3.4	48	15	0.08
EU enlarged	1484	-5.9	48	9.7	0.08
Japan	331	-1.1	48	3.0	0.05
Canada	175	5.2	48	2.4	0.28
Ukraine	254	1.4	48	-5.6	-6.64
Russia	689*	-16.9*	48	0.0	0.00
Annex I (excl. US+Aus.)	2950	-7.6	48	9.4	0.05
non-Annex I				-3.7	-0.03

*:Baseline of Russia

One solution is to adjust not only the 55% requirement but also the rules for the CDM, like previously in case 2c. While the institutional setting would be different, this case 3b would result in the same outcomes as reported under case 2c: it would lower the permit price and costs for Annex I, while raising CDM revenues for non-Annex I. Changing the CDM rules within the KP setting may seem easier than setting up an alternative legal and institutional framework when the KP does not enter into force (case 2c). However, it may also provide

parties opposing the KP more possibilities to obstruct any formal decisions on changing rules¹⁹ (see Chapter 6).

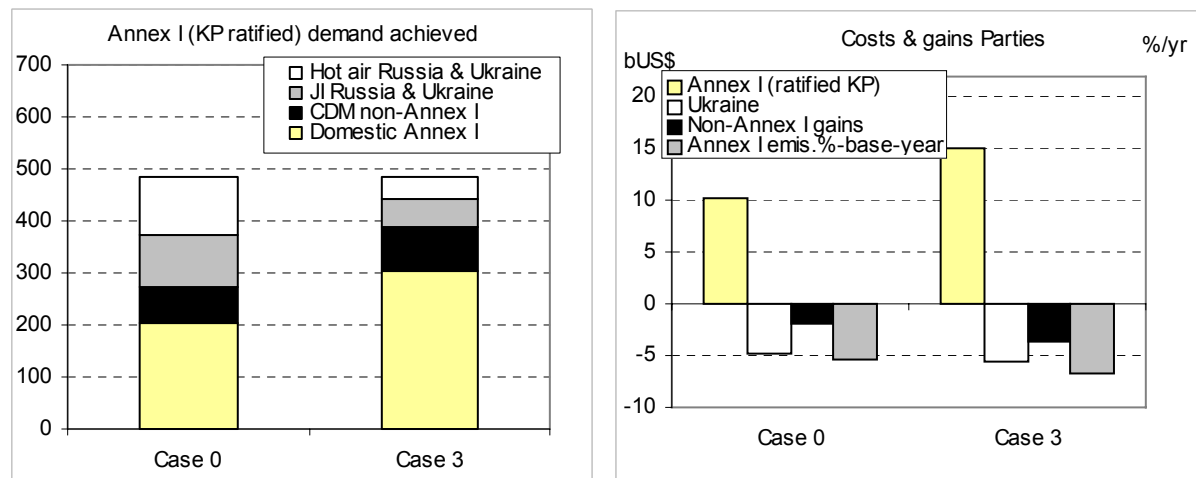


Figure 7: The components of the total Annex I (KP ratified) annual emission reductions (domestic, hot air (surplus emissions), JI and CDM) (a: left) and the annual costs and gains of the different Parties and environmental effectiveness (b: right) under case 3 (compared to case 0).

5.4 Option 4: KP with adjusted targets

Another option is not just amending the 55% requirement, but also adjusting the KP targets. Countries like Canada and Japan might be allowed to adjust their reduction targets. However, this solution introduces the risk of other KP coalition Parties making similar demands, resulting in a proliferation of claims that, eventually, may become a very time-consuming re-negotiation of the burden-sharing arrangement of KP. For this reason, we propose a simpler – one-shot – solution: a proportional adjustment of all targets. In that case, the Assigned Amounts (AAs) of all Parties under the KP will be adjusted with the same percentage.

Clearly, this will only apply to the countries that have ratified the KP and hence not for the US and Australia. However, if the latter two decided to ratify at a later date it should apply for them as well. To provide certainty to all Parties, though, there should be a deadline after which the old KP targets would still be applicable to those Parties that have not yet ratified the KP.

How much could the targets be relaxed in order to meet all criteria: no reduction of the environmental effectiveness, acceptable costs, and more benefits for non-Annex I countries? From an environmental point of view this relates particularly to the question on the amount of surplus emissions of Russia under the KP. As was shown in the previous cases without Russia, the environmental effectiveness of action taken by the other Parties increases substantially if the Russian surplus emissions are no longer available. In the original Marrakech Accords case it is assumed that the Russia and the Ukraine will only sell part of their surplus emissions to maximise revenues and bank most of it for future commitment periods. However, if Russia does not ratify, it means that the total amount of its surplus emissions will have vanished, as it can no longer be banked. This means that the room for adjusting the targets of the other Parties upwards is dependent on the expected amount of the surplus emissions of Russia in the first commitment period.

¹⁹ Although the expansion of the CDM to sector-based CDM may not require amending the KP/Marrakech Accords, it probably would require decisions by the CoP/MoP to change rules.

This raises the question of how much surplus emissions from Russia there would be? The estimates of the amount of surplus emissions of Russia in 2010 ranges widely and have changed over time (Table 8). The estimates from the Russian government in its Third National Communication (NCR, 2003) for CO₂ emissions range between 12 and 25% of its base year levels (about 2360 MtCO₂-eq), with a central projection of 20%. Interestingly, EIA in its most recent estimates comes with very similar figures projecting the amount of CO₂ emissions to be between 94 – 278 MtC or between 9 – 23% below 1990 levels, while in its reference estimate the amount of surplus emissions is even lower than the Russian central estimate: 242 MtC or 16%. In our earlier analysis of the KP (den Elzen and de Moor, 2001), based on the implementation of the IPCC SRES scenarios, we estimated CO₂ emissions of Russia to range between 187 - 252 MtC or 22-32% below 1990 levels. While these seemed to be on the high end, they are within the range reported by Grubb et al. (2003).

Table 8: Percentage projected change in Russia's GHG emissions in the 1990-2010 period, and amount of surplus emissions (hot air) according to different studies

Study	Scenario	%-change fossil CO ₂ emissions (1990-2010)	Surplus emissions in CO ₂ (CO ₂ -eq in MtC)***
IMAGE-team (2001)	IPCC A1b	-22 (-17*)	187 (185*)
	IPCC B2	-32 (-27*)	252 (277*)
IEA (2002)	Reference	-17	155
EIA (2003)	Reference	-23	194
	Low	-26	213
	High	-9	103
NCR (2003)**	Reference	-20	174
	Low	-25	207
	High	-12	123
Grubb et al. (2003)	Low	-44	330
	High	-28	226

* All GHGs; ** Russian Third National Communications, for the Russian Federation only.

*** Calculated as the difference between the 2010 emission projections based on %-change (column 3) times the 1990 levels (830 MtC (all CO₂-eq), and 644 MtC CO₂ for Russia) and the assigned amounts (in CO₂ or CO₂-eq) plus the 45 MtC due to sink credits (den Elzen and de Moor, 2002a).

Most estimates are for CO₂ emissions only. For defining new targets, we need to include not just CO₂, but also other non-CO₂ GHGs. This is not easy due to the lack of projections for non-CO₂ GHG emissions. According to the Third National Communication, the share of non-CO₂ GHG emissions in total GHG emissions changed from 23% in 1990 to about 20% in 1999 (Table 9).

Table 9: Trends in GHG emissions in Russia (figures in MtC eq.) (Source: NCR (2003))

GHG	1990	1994	1995	1996	1997	1998	1999	1990-99*
CO ₂	644	544	434	409	417	412	412	64
CH ₄	150	112	106	106	82	85	79	53
N ₂ O	27	13	12	11	12	9	10	36
PFCs, HFCs & SF ₆	11	10	10	10	11	11	11	106
Total	832	586	562	537	521	518	513	62

* Calculated index using emission values without rounding

Under economic recovery non-GHG emissions will grow less quickly than CO₂ emissions since the application of new technologies and better maintenance of distribution systems will result in lower emissions. This seems particularly the case for methane emissions and the F-gases. On the other hand, a continued strong (export-led) growth in the energy production sector (including enhanced exploration and exploitation of oil and gas fields)

may result in an increase in GHG emissions. If non-CO₂ emissions were to grow less quickly than CO₂ emissions the surplus emissions estimates for CO₂ equivalent GHG emission levels will tend to be higher than for CO₂ only. Given the uncertainty in these projections, we here assume that CO₂ equivalent surplus emissions levels will be proportional to those of CO₂ only.

In deciding on the level of relaxation of the emission targets for an adjusted KP without Russia, we take a cautious approach towards the amount of surplus emissions. If we overestimated the level of surplus emissions, the eventual environmental effectiveness of the KP would be worse than with Russian participation in the KP. Therefore, in our calculations we will now take 75 MtCeq. to be re-distributed amongst the other KP. This amount is well below the lowest IEA (2003) projection of Russian surplus emissions levels (103 MtC) for CO₂ only, excluding additional Assigned Amounts for sinks (Table 8). Thus it is unlikely that this amount will result into an environmental effectiveness that is worse than the present KP, even under high economic growth in Russia and if all banked surplus emissions were compensated for in future negotiations. If we re-distribute this 75 MtCeq., it implies that the AAs of the other Parties, excluding US, Australia and Russia, but including Ukraine, would increase by about 3% compared to the AAs under the Marrakech Accords. Here, we assume every country that has ratified the KP gets a share of the additional 75 MtCeq. proportional to its share in the total AAs under the Marrakech Accords (2287 MtCeq.). It implies a change in the targets for Canada from +5.2% of base year levels to +8.3%; for Japan from -1.1% to +2% and for the enlarged EU from -5.9% to -2.8% (see Table 10 and Appendix A).

Table 10. Kyoto Protocol and New Kyoto Protocol Quantified emission limitation or reduction obligations, in per cent of base year emissions of all GHGs (CO₂ equivalent)

	Base-year	Assigned Amounts Kyoto '97	Sinks credits (Marrakech)	Assigned Amounts including sinks	QELRO compared to base		Re-allocation excess emissions FSU*	Assigned Amounts including excess emissions FSU	New QELRO compared to base
					KP	Marrakech			
	MtC/yr	MtC/yr	MtC/yr	MtC/yr	Base year = 100	Base year = 100	MtC/yr	MtC/yr	Base year = 100
Enlarged EU	1576	1455	28	1484	95.0	94.1	49	1533	97.2
Rest Europe	15	13	1	14	94.6	96.5	0	15	103.0
Canada	166	157	19	176	96.7	105.2	5.3	180.8	108.3
Japan	335	315	16	331	96.7	98.9	10.6	341.6	102.0
New Zealand	20	20	8	28	102.9	140.3	0.7	28.6	143.7
Ukraine	250	250	4	254	100	101.4	8.5	262.8	104.8
Russia	829	829	41	870.4	100	105.0	0	870.4	105.0
Annex I without US & Australia	3192	3040	117	3156	100	105		3380.0	101.6
US	1655	1540	55	1594	93.0	96.3	0.0	1594	96.3
Australia	135	145	4	149	108.0	110.6	0.0	149	110.6
Annex I	4982	4725	175	4900	94.8	98.3	75	4975.0	99.9

Overall, the environmental effectiveness of the new KP would be somewhat better than under the Marrakech accords: -5.7% instead of -5.4% (including the Russia and the Ukraine) (compare Table 11 and Table 1). Although the emission permit price would be higher (\$US37 versus \$US28 per ton C), the total costs for the Kyoto countries excluding the Ukraine would be about the same as under the Marrakech Accords case (about b\$US 10.2). The higher emission permit price does however result in higher CDM revenues for the non-Annex I countries: about b\$US 2.4 instead of b\$US 1.9 per year.

We can thus conclude that the new KP without Russia and with relaxed targets would meet all our environmental and economic criteria: while the costs of implementing the KP are

about the same, both the CDM revenues for non-Annex countries and the environmental effectiveness would improve. Moreover, where in the Marrakech case a major part of the surplus emissions is banked and thus still in the system, in the relaxed targets case most surplus emissions, i.e. the Russian surplus emissions, are definitely vanished.

Table 11: Cost and environmental effectiveness of KP without Russia with adjusted targets

Case 4	Environmental effectiveness		Economic efficiency		
	Assigned Amounts/yr (MtC)	%-change base-year	Permit price (US\$/tC)	Costs/yr (bUS\$)	Effort rate (%-GDP)
Annex I ratified KP	2320	-1.8	37	10.2 ^v	0.05 ^v
EU enlarged	1533	-2.8	37	6.4	0.05
Japan	342	2.0	37	2.1	0.03
Canada	181	8.3	37	1.7	0.20
Ukraine	259	3.4	0	-4.1	-4.78
Russia	689*	-16.9*		0.0	0.00
Annex I (excl. US+Aus.)	3009	-5.7	37	6.1	0.03
non-Annex I			37	-2.4	-0.02

Baseline of Russia; ^v costs excluding the gains for Ukraine

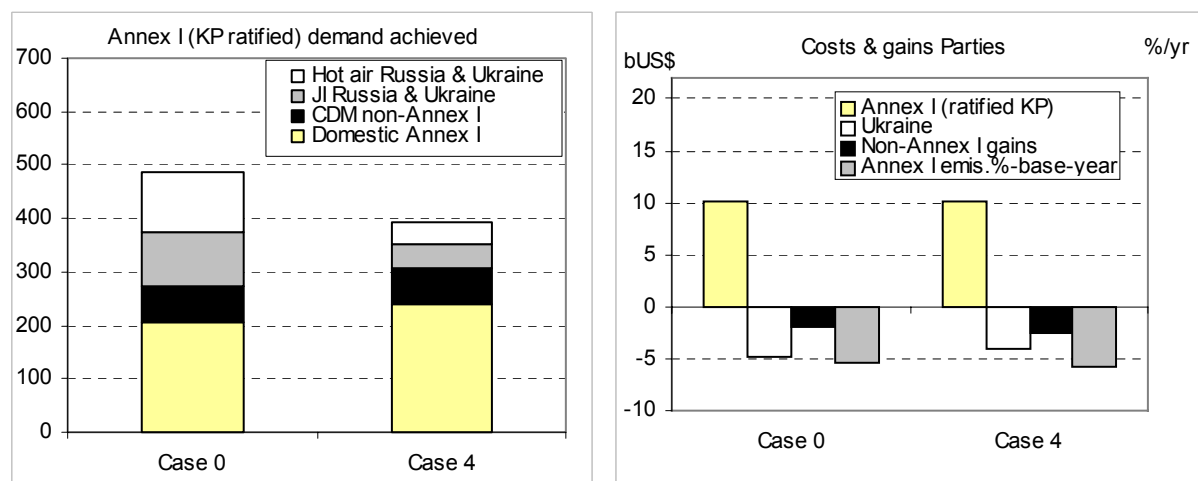


Figure 8: The components of the total Annex I (KP ratified) annual emission reductions (domestic, hot air (surplus emissions), JI and CDM) (a: left) and the annual costs and gains of the different Parties and environmental effectiveness (b: right) under case 4 (compared to case 0).

5.5 Ukraine has ratified, but cannot participate in IET

In all of our previous analyses it was assumed that the Ukraine would be able to fully participate in emission trading. However, it is not certain that they will be able to meet all eligibility requirements for engaging in emission trading. For this reason we also analysed what would happen to our findings if the Ukraine were not able to participate in emission trading (see Table 12).

The results show that:

- the international permit price and the costs for the Kyoto countries would be much higher without the Ukraine in all alternative cases (2a – 4);
- the case where the KP targets would be relaxed by redistributing 75MtCeq. would result in a higher environmental effectiveness and larger revenues for non-Annex I countries, but higher costs for the Kyoto countries than under the Marrakech Accords. However, the cost would still be much lower than without adjustment of the targets.

Table 12. Environmental effectiveness and costs of all cases, if Ukraine cannot participate in IETs

		Case 0	Case 1	Case 2a	Case 2b	Case 2c	Case 3	Case 4
Environmental effectiveness								
Annex I ratified KP	Demand (MtC/yr)	486	834	486	486	486	486	395
Russia & Ukraine	Surplus emissions (MtC/yr)	-113	-201	0	0	0	0	0
non-Annex I Annex I	JI (MtC/yr)	-99	-103	0	0	0	0	0
	CDM (MtC/yr)	-70	-84	0	0	-228	-79	-66
	Domestic (MtC/yr)	-190	-425	-429	-424	-234	-356	-275
	IET/JI (MtC/yr)	-15	-23	-57	-62	-25	-51	-54
Netto		0	-1	0	0	0	0	0
%change base-year emissions		-5.4	-2.7	-9.0	-9.0	-9.0	-9.0	-5.8
Economic efficiency								
Permit price	US\$/tC	28	25		113	41	85	60
Annex I (ratified KP)	Costs/yr (bUS\$)	10.1	9.1	24.4	22.2	13.5	20.0	11.3
Russia & Ukraine	Costs/yr (bUS\$)	-4.8	-6.2	0.0	0.0	0.0	0.0	0.0
Non-Annex I	Gains/yr (bUS\$)	1.9	2.1	0.0	0.0	7.4	6.6	3.8

6 Evaluation of the feasibility of alternatives for Russian ratification of the Kyoto Protocol

In the previous chapter, we explored a number of options for preserving the KP in case Russia does not ratify it. We particularly looked into their implications in terms of their environmental effectiveness, costs for Annex I countries and CDM revenues for non-Annex I countries. Here, we will make an overall evaluation of the options explored on the basis of the criteria identified in Chapter 3. First, we will look into more detail into the legal, institutional and practical implications of the alternative options. Next, we will come to an overall evaluation of the feasibility of the various options.

6.1 *Legal and institutional aspects of implementing the KP without Russia*

Apart from the re-entrance of the US, all cases for implementing the KP without Russia explored require extra legal and institutional arrangements for their implementation. In some cases (cases 3a,b and 4) these concern arrangements within the UNFCCC, such as amending the KP (with respect to the 55% requirement, rules for CDM, and AAs). In other cases these concern arrangements outside the UNFCCC, such as the adoption of an international agreement substituting or supplementing arrangements in the KP and UNFCCC (cases 2b, c).

Rules for amending the KP are laid down in Article 20 of the KP. However, since the KP has not entered into force, this Article is not yet applicable.²⁰ This means that until the KP has entered into force any amendments of the KP are governed by decision making under the UNFCCC. As the UNFCCC is silent on specific rules for adopting or amending protocols (Article 17), an amendment of the KP constitutes an amendment to the UNFCCC itself (Yamin and Depledge, 2004). In addition, the adoption of supplementary agreements would be based on Article 17. The rules for amendments to the UNFCCC are governed by Article 15 of the UNFCCC and amendments can be adopted by a three-fourth majority of the Parties (present) if all efforts to reach consensus fail. However, in practise majority voting has not been possible, because no consensus on the Conventions rules of procedure on the issue of majority voting could ever be reached.²¹ This impasse means that amending the KP will require decision making by consensus. This provides opponents of amending the KP, like the US, Russia or other (OPEC) countries with blocking power. This problem affects the option of preserving the KP by changing the 55% rule, changing the rules for the CDM and/or changing the Assigned Amounts of Annex I.

This situation of de facto need for consensus is considered a major obstacle for the further evolution of the UNFCCC (Oberthür and Ott, 2003; Yamin and Depledge, 2004). Eventually, it could even become a serious threat to preserving a multilateral approach to the climate problem as it allows a small minority to block action by a large coalition of willing Parties, thus paralysing the functioning of the UNFCCC.

The only option of avoiding this decision making problem is to adopt a separate international agreement outside the UNFCCC by which Parties bind themselves to the

²⁰ Although Yamin and Depledge (2004) suggest that this is unclear (see Chapter 18), the fact that a proposal by the EU prior to COP-3 to allow protocols to be adopted by majority voting and for this amendment to be applied provisionally pending the KP formal entry into force was not adopted, clearly indicates that amendments to the KP pending its entering in to force are governed by the UNFCCC. Note that entering into force of the KP could change the prospects for majority voting, because the Parties blocking majority voting (like OPEC) may not become party to the KP.

²¹ Adoption of these rules has been blocked by OPEC member states.

(amended) provisions of the KP. In addition, this would require the creation of alternative institutional bodies for the implementation of the agreement. As already mentioned, such an approach would have serious drawbacks. It would result into the substantial inefficiency of having parallel institutional frameworks for international climate policy, and it would undermine the functioning and credibility of the UNFCCC. It also seems likely that creating two policy fora will complicate decision making about future climate policies.

Apart from legal and institutional problems, there are also practical problems related to implementing alternatives to the present KP. Both the process of amending the KP as well as the adoption of new substituting or supplementary agreements for setting up an alternative institutional structure outside the UNFCCC will require significant amounts of time, and would again require a process of ratification. In the case of an amendment to the UNFCCC, the proposal needs to be circulated to Parties via the secretariat at least six months before it can be adopted, while at least three-fourth of the Parties would have to ratify the amendment to have it enter into force. Altogether this may take a year or more.²² In the case of a substituting agreement, the requirements for the agreement to enter into force could be simpler, but for the agreement to become functional it would still require sufficient parties ratifying the agreement. Moreover, installing a parallel institutional framework for the implementation of substituting agreements may also require quite some time.

Overall, it can be concluded that notwithstanding the option for majority voting in the UNFCCC, in practice any change in the present KP text will require consensus and is thus likely to be hindered by vetoes from opposing Parties (like the US or Russia). Moreover, any amendment process is likely to take years rather than months and thus may interfere with the first commitment period, let alone the general uncertainty such a process would leave Parties with in preparing for meeting their KP targets. In theory, setting up an alternative institutional framework for implementing the KP would be possible. However, there are serious legal and institutional drawbacks that render such options politically rather unattractive.

6.2 Overall evaluation of the options explored

In Chapter 3 we formulated a number of criteria for evaluating the feasibility of alternative proposals for the KP to be implemented without Russia:

- 1) The environmental effectiveness should be comparable to or even better than under the KP;
- 2) The costs for all Annex I parties that have ratified the Kyoto Protocol should be acceptable; the costs should be comparable to the KP;
- 3) The new arrangement should be acceptable to the non-Annex I countries; in particular the expected revenues from CDM projects should be comparable or even better than the KP;
- 4) The options should be politically acceptable to the Parties involved;
- 5) The options should be legally and practically feasible to be implemented.

We used the FAIR modelling framework to quantitatively evaluate if the various options meet the first three criteria (costs and environmental effectiveness) and qualitatively

²² However, amendments to the existing Annexes (like a change in the reduction target for the US) would not require such a ratification process as they enter automatically in to force three months after adoption. Note that this is no longer the case once the KP would enter into force because then different provisions in the KP apply (Articles 20, 21). Note also that entering into force of the KP could change the prospects for majority voting, because the Parties blocking majority voting may not become party to the KP.

assessed the remaining criteria (political acceptability and legal and practical feasibility). We have summarised the results of our assessment in Table 13.

Table 13: Evaluation of the alternative cases versus the Marrakech Accords (=case 0)

	Case 0	Case 1	Case 2a	Case 2b	Case 2c	Case 3a	Case 3b	Case 4
Evaluation Criteria								
• Environmental effectiveness	+	++	++	++	++	++	++	+
• Costs Annex I*	+	+	--	-	++	-	++	+
• Gains non-Annex I	+	+	--	--	++	++	++	+
• Political acceptability**	+	--	--	+/-	-	+/-	+/-	+/-
• Legal and practical feasibility	+	+/-	+	+/-	--	--	--	--

Legend: ++: better than Marrakech Accords; +: comparable; +/-: unclear; -: worse; --: much worse.

*: Only Parties participating and with net costs; **: For Parties participating

Environmental effectiveness:

The environmental effectiveness of all alternative cases is better than or comparable to the Marrakech Accords case, including the case with relaxed targets (case 4). This is due to the exclusion of the Russian surplus emissions or the broader participation (case 1 with US + Australia).

Costs for Annex I Parties:

The costs for Annex I parties participating are significantly higher in the cases of implementation of the KP targets without the KP entering into force (and thus no availability of the CDM) (2a and 2b) and if only the 55% requirement in the KP were amended (case 3a). However, whether costs in the latter case would become unacceptable is difficult to say. The costs estimates presented are uncertain and could well be higher or lower depending on factors such as baseline developments, mitigation costs estimates (MACs used) and the functioning of the Kyoto Mechanisms, including effective use of market power by the Ukraine as the single seller of emission credits.

Gains for non-Annex I Parties:

In most cases, the non-Annex I Parties are not worse off than in the Marrakech Accords case, except when there is no CDM (case 2a and 2b). As would be expected, they are much better off under the enhanced CDM cases, irrespective if this would be under an amended KP (case 3b) or a separate arrangement (case 2c).

Political acceptability:

The political acceptability of the various cases is more difficult to evaluate than the other criteria. Nevertheless, we believe that some cases are less likely to be acceptable than others. As argued before it is unlikely that the US would re-enter the KP, even with more relaxed targets, and even if all other Parties would be willing to accept such an amendment of the US target. It also seems unlikely that all Annex I Parties would be willing to implement the KP targets if the KP does not enter into force (case 2a), even if there would be an option of linking emission markets (case 2b). Although less clear, it seems there might even not be general support for amending the 55% requirement (case 3a) for both political and economic reasons. Finally, the option of creating a separate agreement outside the UNFCCC structure (case 2c) to implement the KP provisions, including the KMs, most likely will meet political resistance for reasons of weakening the UNFCCC.

Legal and practical feasibility:

As discussed above (paragraph 6.1) it seems that from a legal and practical perspective all options of either amending the KP (cases 3 and 4) or adopting alternative or supplementary agreements (case 2b and 2c) seem to face major problems. Adjustment of the US KP target only (case 1) could be easier, but would also require consensus. Only implementing the KP targets if the KP does not enter into force and possibly linking the emission markets of participating Annex I countries could be feasible options.

From the evaluation, we can conclude that none of the alternative options explored is likely to meet all of our requirements. Thus, there does not seem to be a real alternative to Russian ratification of the Kyoto protocol, even after the recent announcement by the Ukraine that they will ratify. Ratification by the Ukraine would decrease the costs of implementing the KP targets without Russia, but practically it seems difficult to make use of this change due to the difficulty of amending the KP.

7 Conclusions

The entering into force of the Kyoto Protocol has become uncertain due to the postponement of the ratification process in Russia. In this report we explored some options in case Russia would be unwilling to ratify the KP. These options would need to meet a number of criteria for being generally acceptable:

- the environmental effectiveness should not be worse;
- the costs to Annex I Parties should be acceptable;
- non-Annex I Parties should gain economically;
- politically acceptable to the Parties involved;
- legal and practically and feasible to be implemented.

One option would be to obtain Russian ratification of the KP by trying to get the US back on board on, albeit on softened terms: stabilisation at 2000 levels by 2010 according to the McCain-Lieberman proposal. This option would meet the environmental and economic criteria; the effectiveness of the KP would be enhanced, revenues for Russia would increase and the costs for the US would become comparable to those of the EU. However, it does not seem politically acceptable for the US, even under a new Democratic president.

Another option would be that the EU, Canada and Japan implement the KP targets without the KP entering into force. This option would be about twice as costly, even if national emission trading markets could be linked in time (which seems unlikely) and the Ukraine was included in the emission trading. It would also result in no benefits for non-Annex I countries. Therefore, we also explored the option of preserving the CDM outside the KP and making it more effective. This option would reduce the cost of implementing the KP targets, while increasing non-Annex I revenues compared to an entering into force of the KP. If this last option would be politically acceptable is unclear, though, because setting up alternative legal and institutional frameworks outside the UNFCCC could be considered undermining the UNFCCC.

We also looked at options of amending the KP. Lifting only the requirement that the ratifying countries constitute 55% of the 1990 CO₂ emissions will not be sufficient as the cost of meeting the KP targets without Russian ratification even with ratification by the Ukraine would probably remain too high. One option would be to enhance the contribution of the CDM. That would reduce the cost and result in more revenues for developing countries. Another option would be to also adjust (relax) the KP targets. The amount of surplus emissions avoided if Russia does not participate allows for a general relaxation of the targets for the Kyoto coalition. It was found that a re-distribution of a conservative part of this surplus emissions (75MtCeq) would allow for a uniform relaxation of the KP coalition targets that would keep the costs of implementation acceptable, while its environmental effectiveness would remain unaffected and CDM revenues for non-Annex I countries would increase.

However, all options that require amending the KP or setting up alternative legal and institutional arrangements for implementing the KP targets without the KP entering into force, encounter major legal and/or practical problems. The stalemate on majority decision making within the UNFCCC provides opponents of amendments to the KP veto power. Moreover, the time required for ratification of amendments to the KP or supplementary or alternative legal arrangements will also result in significant time delays, possibly some years. Thus, particularly due to legal and practical reasons, options for preserving the KP without Russian participation look very bleak.

Assuming Russia's reluctance to ratify is based on tactical rather than strategic considerations, the best way forward seems to highlight the economic and political gains of Russian ratification, and – if needed – to link the issue of ratification to other issues, such as Russian membership of the World Trade Organisation. By involving policy makers at the highest level (i.e. heads of state) a political deal might then be reached.

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Appendix A: Summary New QELROs of Annex I Parties

Table A.1 Kyoto Protocol and New Kyoto Protocol Quantified Emission Limitation or Reduction Obligations (QELROs) in percentage of base-year emissions of all GHGs (CO₂ equivalent) for the Annex-I

	Base-year	Assigned Amounts Kyoto '97	Sinks credits (Marrakech)	Assigned Amounts including sinks	QELRO compared to base		Re-allocation excess emissions FSU	Assigned Amounts including excess emissions FSU	New QELRO compared to base
					KP	Marrakech			
Annex I Parties	MtC/yr	MtC/yr	MtC/yr	MtC/yr	Base year = 100	Base year = 100	MtC/yr	MtC/yr	Base year = 100
Australia	134.54	145.30	3.53	148.8	108	110.6	0.0	148.8	110.6
Austria	21.04	19.36	0.84	20.2	92	96.0	0.7	20.9	99.1
Belgium	37.24	34.37	0.40	34.8	92	93.1	1.2	35.9	96.2
Bulgaria	42.84	39.42	0.79	40.2	92	93.9	1.3	41.5	96.9
Canada	166.17	156.84	18.66	175.5	94	105.2	5.3	180.8	108.3
Czech Rep.	51.74	47.63	0.84	48.5	92	93.6	1.6	50.1	96.7
Denmark	19.08	17.55	0.33	17.9	92	93.7	0.6	18.5	96.8
Estonia	11.10	10.22	0.21	10.4	92	93.9	0.3	10.8	97.0
Finland	20.51	18.87	0.37	19.2	92	93.8	0.6	19.9	96.9
France	148.96	138.95	2.37	141.3	92	93.6	4.7	146.0	96.7
Germany	330.28	303.85	4.54	308.4	92	93.4	10.2	318.6	96.5
Greece	29.28	26.94	0.38	27.3	92	93.3	0.9	28.2	96.4
Hungary	27.72	26.05	0.57	26.6	94	96.0	0.9	27.5	99.2
Iceland	0.70	0.77	0.07	0.8	110	119.5	0.0	0.9	123.2
Ireland	14.59	13.42	1.10	14.5	92	99.6	0.5	15.0	102.7
Italy	141.64	130.36	2.07	132.4	92	93.5	4.4	136.8	96.6
Japan	334.78	314.71	16.35	331.1	94	98.9	10.6	341.6	102.0
Latvia	9.73	8.95	0.44	9.4	92	96.5	0.3	9.7	99.6
Liechtenstein	0.07	0.07	0.00	0.1	92	93.0	0.0	0.1	96.1
Lithuania	14.06	12.93	0.42	13.4	92	95.0	0.4	13.8	98.1
Luxembourg	3.67	3.37	0.05	3.4	92	93.3	0.1	3.5	96.4
Monaco	0.03	0.03	0.00	0.0	92	93.0	0.0	0.0	96.1
Netherlands	59.77	54.99	0.63	55.6	92	93.1	1.8	57.5	96.1
New Zealand	19.90	19.93	8.04	28.0	100	140.3	0.7	28.6	143.7
Norway	14.22	14.36	0.56	14.9	101	105.0	0.5	15.4	108.4
Poland	153.89	144.66	2.36	147.0	94	95.5	4.9	151.9	98.7
Portugal	17.12	16.02	0.39	16.4	92	94.2	0.5	17.0	97.3
Romania	72.24	66.46	1.82	68.3	92	94.5	2.2	70.5	97.6
Russia	826.6	829.11	41.3	870.4	100	105.0	0.0	870.4	105.0
Slovakia	20.79	19.15	0.71	19.9	92	95.4	0.6	20.5	98.5
Slovenia	5.24	4.82	0.41	5.2	92	99.9	0.2	5.4	103.0
Spain	84.13	77.40	1.51	78.9	92	93.8	2.6	81.5	96.9
Sweden	19.25	17.71	0.77	18.5	92	96.0	0.6	19.1	99.1
Switzerland	14.46	13.30	0.65	14.0	92	96.5	0.4	14.4	99.6
Ukraine	250.70	250.70	3.62	254.3	100	101.4	8.5	262.8	104.8
UK	208.84	186.81	3.27	190.1	92	93.6	6.3	196.4	96.7
US	1655.4	1539.5	54.75	1594.3	93	96.3	0.0	1594.3	96.3
Annex I	4982.3	4724.9	175.0	4900.0	94.8	98.3	75	4975.0	99.9
Total w/o US	3326.9	3185.4	120.0	3306	95.7	99.4	75	3380.0	101.6
Total w/o US and Australia	3192.0	3040.0	117.0	3156.9	95.2	98.8	75	3232.0	101.6
Enlarged EU	1576	1455	28	1484	95.0	94.1	49	1533	97.2
Rest Europe	15	13	1	14	94.6	96.5	0	15	103.0
Canada	166	157	19	176	96.7	105.2	5.3	180.8	108.3
Japan	335	315	16	331	96.7	98.9	10.6	341.6	102.0
New Zealand	20	20	8	28	102.9	140.3	0.7	28.6	143.7
Ukraine	250	250	4	254	100	101.4	8.5	262.8	104.8
Russia	829	829	41	870.4	100	105.0	0	870.4	105.0
Annex I wo US, Australia	3192	3040	117	3156	100	105		3380.0	101.6
US	1655	1540	55	1594	93.0	96.3	0.0	1594	96.3
Australia	135	145	4	149	108.0	110.6	0.0	149	110.6
Annex I	4982	4725	175	4900	94.8	98.3	75	4975.0	99.9

Appendix B: The modelling framework

The abatement costs model of FAIR makes use of aggregated permit demand and supply curves, derived from Marginal Abatement Cost (MAC) curves for the different regions, gases and sources (den Elzen and Lucas, 2003).²³ The permit demand and supply curves are used to determine the international market equilibrium permit price (henceforth known simply as ‘permit price’) on the basis of the same methodology as applied by Ellerman and Decaux (1998). This methodology distributes the regional emission reduction objective over the different gases and sources following a least-cost approach, taking full advantage of the flexible Kyoto Mechanisms (KMs) as defined under the KP, i.e., IET, JI and CDM. Subsequently, the permit price is used to determine the buyers and sellers on the international trading market, the accompanying financial flows of permit trading and the regional abatement costs resulting from domestic and external abatements.

We used different sets of MAC curves for different emission sources here. For the energy and industry-related CO₂ emissions, we employed response curves from the TIMER energy system model (van Vuuren et al., 2003). These include technological developments, learning effects and system inertia. For the energy and industry related non-CO₂ GHG emissions, we used the 2010 MAC curves of Criqui (2002). These are based on detailed abatement options per gas and per source. For the sink credits from ARD projects, we used the MAC curves of Graveland et al. (2002), while taking conservative estimates, along with negligible costs for sinks from Forest Management (FM). For the use of the Kyoto Mechanisms, transaction costs, consisting of a constant US\$0.50 per ton CO₂-eq emissions plus 2% of the total costs, were assumed. Due to the project basis of CDM, only a limited amount of the abatement potential is assumed to be operationally available on the market. We have set this availability at 10% of the theoretical maximum in 2010. For IET and JI we assumed full availability.

²³ A MAC curve, differing per country, reflects the additional costs of reducing the last unit of carbon.